"DISCHARGE OF HIGH VOLTAGES IN VACUA" IN THIS NUMBER

THE ELECTRICAL EXPERIMENTER

NOV. 1914

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High Voltage Discharges Thru Vacuum Tubes

Some of the Wonderful and Spectacular Effects Obtained

THE discharge of high voltage, more particularly that delivered by an induction coil of the "Bull Dog" type and giving one inch or more spark, thru vacuum tubes, gives very beautiful

Fig. 1.

and wonderful results, as will be evident from the illustrations herewith. First,

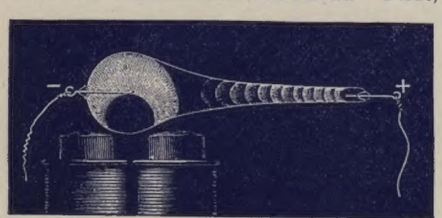

Fig. 5.

we see how such a discharge looks when passed thru the flame of a candle at Fig. 1. Beautiful striae or stratification takes place, the current seemingly not finding an evenly conducting path thru the candle flame. The striae seen are believed to be due to a shifting of the gaseous atoms or ions about the path of the discharge or an action takes place similar to electrolysis.

An elementary form of Plucker's Vacuum Tube for observing the striae created by a high voltage induction coil current passed thru it, is observed at Fig. 2. This tube has its central portion greatly constricted and the smaller the bore of this part between the end electrodes, the

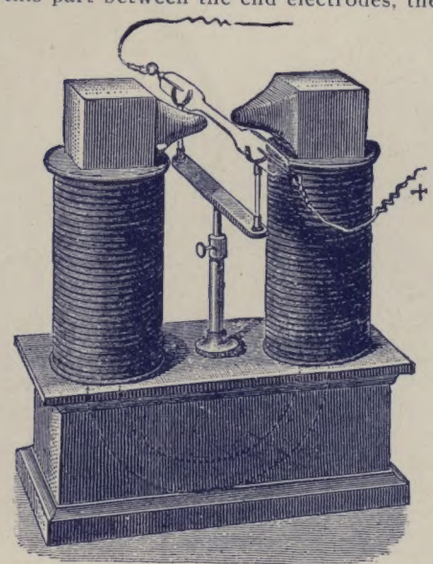

Fig. 6.

more pronounced the striae effects. Plucker has used such a tube with the bore thru its major or central position, so small that it resembled a capillary bore.

When a powerful magnet has its magnetic field of flux concentrated on the striae in such vacuum tubes, (including all Geissler tubes), the effect created is both very wonderful and instructive. At Fig. 3 is illustrated the effect known as Plucker's plane, when the flux of the magnet is concentrated on the negative electrode of the vacuum tube. Stratification is often produced in this manner when none was observable previously. How the magnetic flux effects the stream of electrified ions at the negative electrode of a ball shape tube is shown at

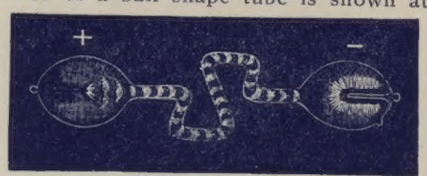

Fig. 2.

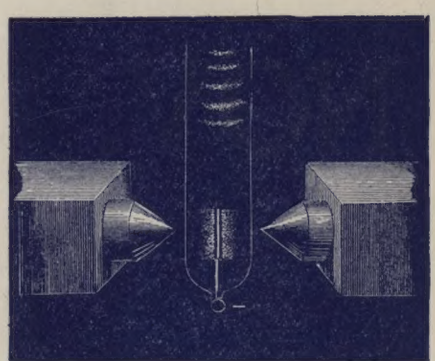

Fig. 3.

Fig. 4, which phenomenon takes the name of "Plucker's curve" after its discoverer. How this curve forms itself when placed over both poles of a powerful magnet is depicted at Fig. 5; the negative electrode phenomenon being

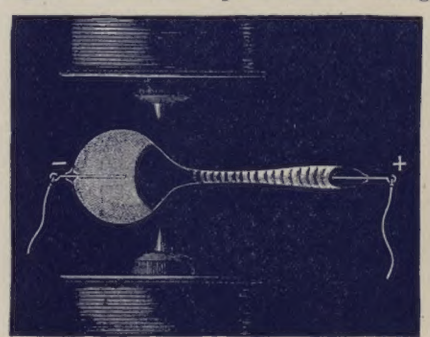

Fig. 4.

here pictured also, as in the previous illustration.

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The form of the electromagnet used for this work is seen at Fig. 6, as also the insulated cradle support for the vacuum tube. Beautiful effects are obtain-

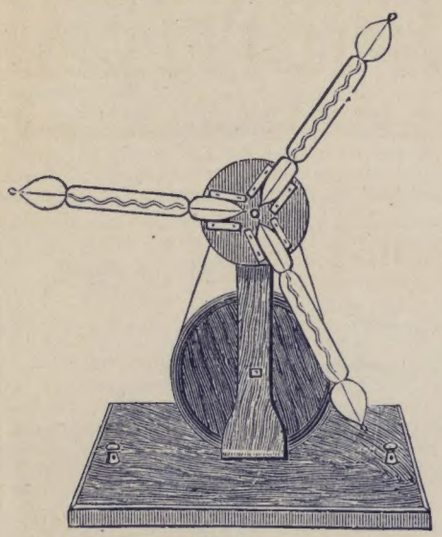


Fig. 7

able when Geissler or Vacuum tubes are rotated. A device for driving a "Star" of three tubes by hand, is illustrated at Fig. 7. A vast number of substances not sensibly phosphorescent when exhibited to any light rays, are made so when subjected to a high voltage electric

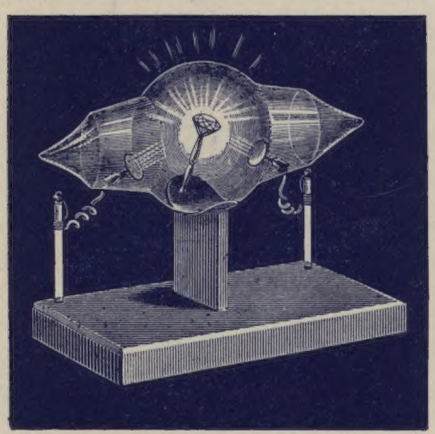


Fig. 8

discharge in a vacuum. Mr. Crookes, of vacuum tube fame, found the diamond to be one of the most sensitive and reliable substances for this experiment.

Our illustration at Fig. 8 shows the phosphorescent diamond, caused by placing it in a vacuum thru which a high

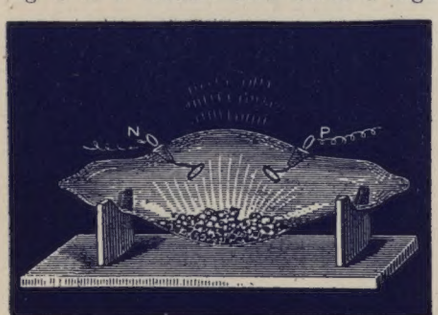


Fig. 9

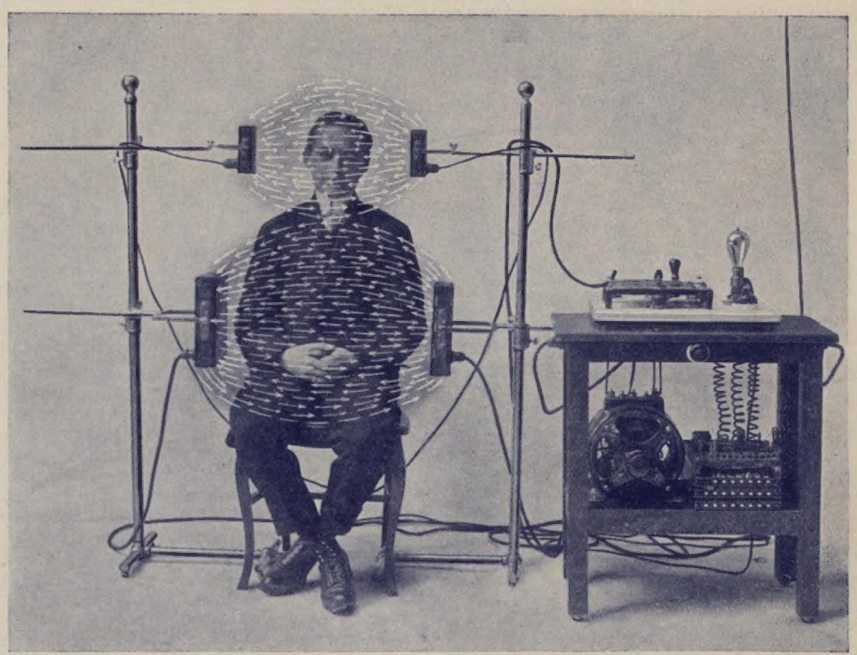
potential electric current is passed. In all these experiments much depends of course upon the degree of vacuum in the bulb or tube; entirely different effects being observed with low and high vacuum respectively. A number of common minerals are mounted up in fancy Geissler tubes obtainable on the market, as diamonds are too expensive for this purpose. The phosphorescense of rubies, (which can be a number of small inexpensive or reconstructed ones), is seen in Fig. 9. The effect is very beautiful and no matter how deep or pale the "natural" hue of the stones, the phosphorescense effect is a bright, rich red; utterly beyond description or imitation in black and white.

THE BACHELET MAGNETIC WAVE HEALING SYSTEM.

Bachelet, of Aerial Railway fame, has also given us a new and efficient means of treating certain human ills, so it is claimed, and a number of careful tests made by duly qualified medical men has proven that the "Bachelet Magnetic Waves," as they are termed really do perform and effect efficient results. Moreover these results are obtained without the usual Tesla or Oudin high voltage and high frequency apparata, which is somewhat dangerous to use and also there is sometimes a bad nervous shock given the patient when these man-created lightning flashes are administered. All this fear of electric shocks, et cetera, is done away with in this apparata, which is used as shown in our illustration.

Where direct current only is available a special switchboard and rotary converter is supplied with the apparatus as alternating current, or at least a pulsating current, must be utilized.

In the words of the inventors and perfectors of this apparatus:—



A Patient being treated by "Bachelet" Magnetic Waves.

The patient or that part of his anatomy under special treatment is placed between the two magnetic wave coils of the Bachelet machine. In accordance with the well-known rules of magnetism, and especially when alternative current is passed thru the coils, an alternating, sinusoidal, and rhythmical magnetic field of flux is produced or set up between the coils and also in any bodies placed in the space separating the coils. These alternating flux lines are suggested by the arrows path in our illustration, and of course, depending upon the frequency of the A. C. supplying the coil, this magnetic field reverses its polarity many times a second, and a frequency of 60 to 120 cycles, etc., can be employed. The magnetic flux lines thus created set up or induce alternating currents in the bodies placed between the two exciting coils and these induced currents produce heat and other curative results thereby, as positively proven by research in the matter due to several prominent physicians.

When in operation a sphere of magnetic lines of force is created between the generators. An inconceivable number of minute magnetic particles, each with its negative and positive pole, are thrown into space by each generator, exchanging polarity with each other within this sphere and penetrating all substances of a non-conductive nature and setting up powerful currents of low voltage and high amperage in all electrical conductors, thereby exciting molecular and cellular activity in the tissues of the human body, magnetizing at the same time the iron, oxygen, and other positive elements in the blood and tissues.

Normally the magnetic field of the earth's atmosphere accomplishes this result.

This magnetization constitutes what is termed "The Electric Potential" of the human body, and without this magnetizing influence it is more than probable that life could not exist upon our planet.

When the electric potential of the human organism is at its normal height the body possesses the necessary vital force to ward off and combat disease. When this vital force becomes diminished the body loses its power of resistance to the attacks of disease and gradually the latter wins the upper hand.

It has been proven by numerous tests that the Bachelet Magnetic Wave Generators DO raise the electric potential of the human body as much as 33 per cent.

Experimental Electricity Course

By S. Gernsback and H. Winfield Secor

LESSON 15.
ELECTROPLATING.
PART I.

Electroplating is the term applied to that art involving the use of the electric current in the electro-deposition of metals or their salts on other metals, or metallically coated substances. Common forms of electroplating, well known to every one now, are the familiar nickel plate on various fittings, utensils, instruments; gold plating and silver plating, as employed in the finer arts, including jewelry, etc., etc.

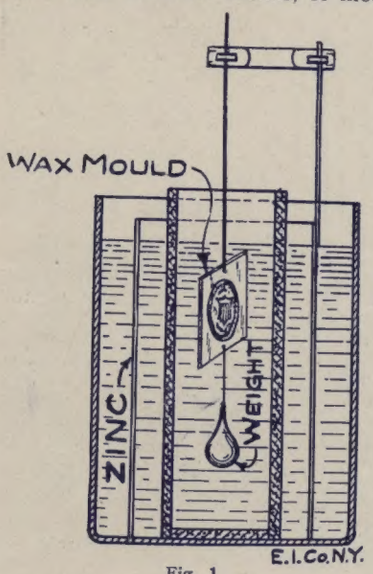


Fig. 1

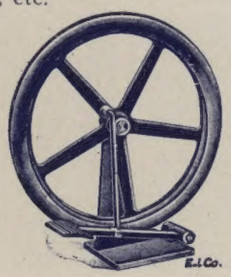


Fig. 3-B. Foot Power Drive.

Besides these more well known phases of electro-deposition of metals is that branch formerly termed galvanoplastic,

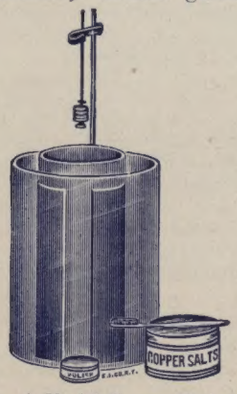


Fig. 2. A Useful Copper Plating Outfit

which has now been abandoned for the term electrotyping, or the electrotype process. The several industrial branches of electro-chemistry, including electrical refining and analyzing, electroplating and electrotyping are now embraced under the general nom de plume of *electrometallurgy*.

Electrotyping was originally evolved by De La Rue, in 1836, who observed that in a Daniell's cell, the copper deposited from the solution upon the copper plate electrode serving as a pole, took the exact impress of the plate, including all scratches, indentations, etc., upon it.

During the year 1839, Jacobi in St. Petersburg, Spencer in Liverpool, and Jordon in London, independently developed out of this discovery, a method of obtaining by the electrolysis of copper, impressions in reversed relief, of coins, ornaments and stereotype plates, etc. Murray, another investigator, made the improvement of using molds of plaster or wax, coated with a film of plumbago in order to provide a conducting surface upon which the deposit could be made.

The making of copper electrotypes is readily affected by suspending a suitable mold in a cell containing a saturated solution of sulphate of copper. Thru the cell a battery current is passed, the mold being connected to the cathode or negative terminal. A copper plate immersed in the solution of the cell, acts as an anode, or positive terminal. The copper anode is gradually dissolved into the solution at a rate equal to the rate

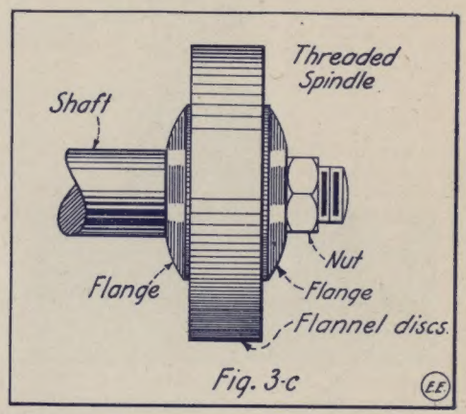
Fig. 3-A. Buffing Head

of deposition at the cathode. Utilizing an external source of current, is more convenient than producing the electrotypes in the actual cell in a Daniell's battery, except, if it is especially designed for the purpose. This process is widely employed at the present time to reproduce repousse and chased ornaments, works of art in fac-simile, and principally for the purpose of multiplying copies of wood block cuts for printing.

The process of forming electrotypes is also sometimes called metallizing. To metallize a non-conductor, such as sealing wax, or rubber, some finely divided metallic powder, such as bronze powder or pulverized plumbago (graphite) is dusted over it. Before applying the powder, the article or mould may, if necessary, receive a very fine coat of wax. Metallizing may also be accomplished by chemically coating such materials as glass, or other objects too fragile to be treated in the manner usually employed in electroplating, with silver or gold by the ordinary chemical silvering or bronzing processes.

The following simple experiment is of interest:

Having procured a brass button, or other stamped metal article with a design in relief, it is well soaked and cleaned with methylated spirit to remove lacquer or grease. Now take a piece of cardboard and, holding it above a Bunsen gas flame, but not igniting it, it is sufficiently warmed to melt good red sealing wax. The wax may then be rubbed into a pool on the upper side of the card. An impression is now made into the wax, having previously breathed on the surface of the brass button just the same as in regular wax sealing. The depth of the impression at the edge need not be anything much below the centre of the edge of the button.



If this has been done successfully, the card is trimmed down, a few drops of alcohol are put on the surface of the wax mould when fine powdered plumbago is brushed over it by means of a soft camel's hair brush. The whole surface exposed should be thoroughly coated with the plumbago, finally brushing off all superfluous material.

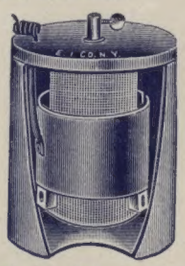


Fig. 4. Primary Cell

The free end of the copper wire connected to the zinc electrode of the plating cell depicted at Fig. 1, is heated slightly and embedded in the sealing wax, with the point projecting just clear of the mold. Over this point a little plumbago is brushed to complete the connection to the face of the mold. The prepared mold, with its plumbago coating, is now to be suspended in the inner porous pot of the plating cell, Fig. 1, as

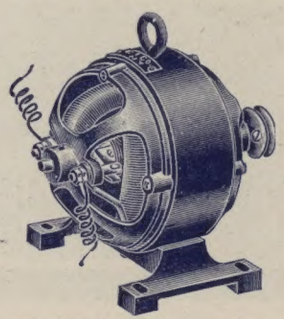


Fig. 5. "Electro" Type S.S. 6 Volt, 4 Ampere Generator

shown, utilizing a weight to hold it down if necessary. The weight should be insulated if used.

The setting up of the plating cell (of the "Electro" make) is done as follows: The glass jar and porous cup are washed out, and the charge of blue stone

Fig. 6. Current Controller

(vitriol) is emptied into the porous cup, which is then filled to within 1½" of the top with hot water, not boiling water. After letting it cool for ten minutes, the mixture may be stirred with a wooden stick. Its color should be deep blue. The zinc cylinder electrode is next placed into the glass jar, and same is filled with a solution consisting of twenty parts water and one part sulphuric acid. The acid must always be poured into the water, and not vice versa, or else the contents of the vessel may be violently ejected into the mixer's face. The porous cup with its solution is placed into the zinc cylinder, noting that the height of the two solutions are both the same.

The object to be plated is attached as seen, to the lower end of the copper wire held by the adjustable clip, allowing of raising and lowering it. Once the object is attached, it is lowered into the porous cup and the plating begins. A very good deposit is obtained in from ten to fifteen minutes, on metal objects. The deposit, of course, is copper. Any metallic object may be coated with it, directions for preparing and cleaning such objects being given fully a little later on.

To resume the subject of metallizing the wax mould with its plumbago coating, it is lowered into the cell solution, within the porous cup. If by chance, the current is too strong, evidenced by burning of the copper deposit which manifests its presence by dark brown smears and marks around the edges, which should normally be of pale salmon pink color, the zinc is suspended a trifle out of the solution. The wax mould is left in the plating cell for approximately twenty-four hours, when it may be removed and stripped. If this does not occur easily, the wax can be melted off with slight heating applied. The electrotype may be cleaned with methylated spirit. If any pin holes appear in the deposit, it is practically certain it is due to imperfect depositing of the copper, or to the presence of loose plumbago on the surface of the mould. When the process has been successful every detail of the original impression is reproduced exactly. If the

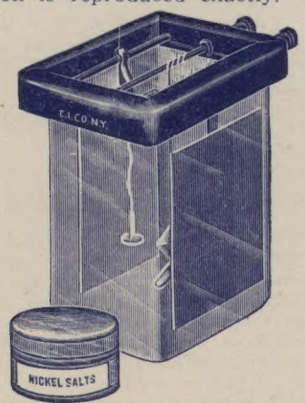


Fig. 7

specimen is to be preserved, a little chloride of zinc may be brushed over the hollow back of the electrotype, having previously cleaned the surface well. A sheet of tinfoil can be burnt on by spreading it over the surface and holding the electrotype face downward over a Bunsen gas flame after which the body of the shell can be filled with molten tin or lead. The following current density values are good ones, being given in amperes per 100 square inches of surface exposed. For copper electrotyping from an acid bath solution, best quality tough deposit 1.5 to 4; good and tough deposit, 10 to 25; solid deposit sandy at edges, 25 to 40; sandy and granular deposit, 50 to 100. For copper deposit from a cyanide bath, 2 to 3; zinc, for refining, 2 to 3; silver, 1 to 3; gold, 5 to 1; brass, 3 to 3.5; iron (steel facing), .5 to 1.5; nickel, begin at 9 to 10 and gradually diminish to 1 to 2.

For copper plating metal articles, such as brass, iron, etc., the object should first be thoroughly cleaned. Begin by hanging the article in boiling caustic soda solution for five to ten minutes, which serves to remove all dirt and grease from the surface. Rinse the object in cold water and it is then ready for plating. In case the object emerges from the plating bath rough with fine holes on the surface, it is most probably due, to insufficient cleaning; and it should be recleaned. Brass and iron objects should be particularly well scrubbed with the hot caustic soda solution to remove all dirt from crevices, etc. When the plating deposit has been made heavy enough, the article can be rinsed in cold water,

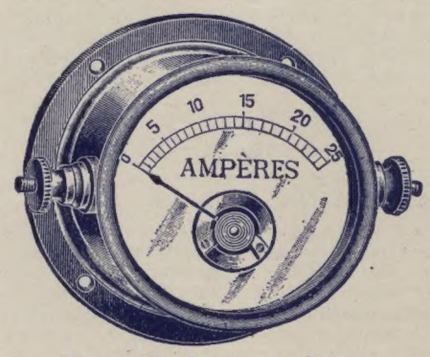


Fig. 9. The Ammeter or Current "Quantity" Gauge

and dried by rubbing with a piece of flannel, or by rolling in fine sawdust. The latter is the method usually employed in all commercial plating shops.

Small animals, flowers, lace, etc., are metallized by first cleansing in methylated alcohol and while moist, they are thoroughly dusted with plumbago, filling all the crevices and indentations. A wire is then fastened to any part of the object and plumbagoed to the object to make perfect connection. It is then suspended into the porous cup and the copper plating begins. Very beautiful and artistic work can be accomplished in this manner. A cut of the "Electro" copper plating outfit is shown at Fig. 2.

For cleaning up articles preparatory to plating, a power head or buffer head, consisting of an iron standard with a short shaft threaded to fit nuts at each end, and mounted with a driving pulley at the centre, as seen in Fig. 3-A, is very useful. The buffing wheels employed for polishing the plated articles are soft and composed of numerous discs of cotton flannel, sewed in circles and held on the buffing head spindle by a flange plate and nut, as seen in Fig. 3-C. Scratch wheels with wooden or wire bristles can also be fitted onto the buffing head as well as emery wheels, for preparing articles for plating. To drive the buffing head spindle, a foot power treadle will be found handy if motor power is not at hand. A usual form of foot power drive is shown at Fig. 3-B.

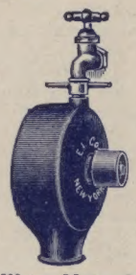


Fig. 8. Water Motor for Driving Dynamos

For small plating work batteries can be employed for the source of electrical energy. Some form of closed circuit battery is imperative, a good type being the Gordon primary battery cell, depicted at Fig. 4. These cells give about 7/10 volt each, and have enormous ampere hour capacity ranging up to several hundred ampere hours in the large sizes. They are suited to constant load and sufficient cells can be connected in series to give the desired voltage. For some outfits, a plating dynamo may be more suitable, as when water power, etc., is available to drive it. A suitable dynamo is depicted at Fig. 5. Plating dynamos, as a rule, do not deliver over 6 volts but 15 to 20 amperes in small units, and they are generally shunt wound, viz., the field winding is connected on multiple with the armature brushes; series dynamos are too apt to be reversed by back E. M. F. from the plating tank, which acts as a battery. The "Electro" No. 810 and type "S S" dynamos are suitable.

A useful variable resistance or rheostat for controlling the amount or strength of the plating current, is seen at Fig. 6. This rheostat permits of the finest regulation and can carry 2 amperes for any length of time. It is connected in series with one of the lead wires going to the plating tank.

In preparing smooth finished articles on the flannel buffing wheel they are held against it firmly, applying some polishing rouge from time to time to the wheel. Rough surfaces must be dressed down before attempting to plate them by filing and grinding on an emery wheel, finishing them on the flannel wheel with polish rouge.

Having given these details consideration, attention may be turned to the subject of nickel plating. The first part will deal with a small nickel plating plant, such as that built by the Electro Importing Company. The illustration, Fig. 7,

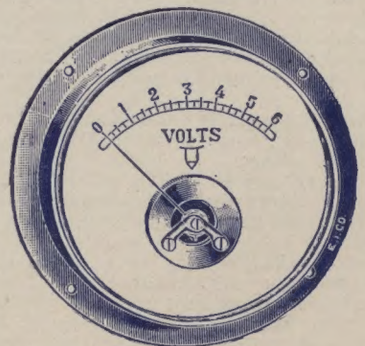


Fig. 9. The Voltmeter or Current "Pressure" Gauge

shows their nickel plating set complete, with glass jar for holding the solution, nickel salts, etc.

(To be Continued)

THE CONSTRUCTOR

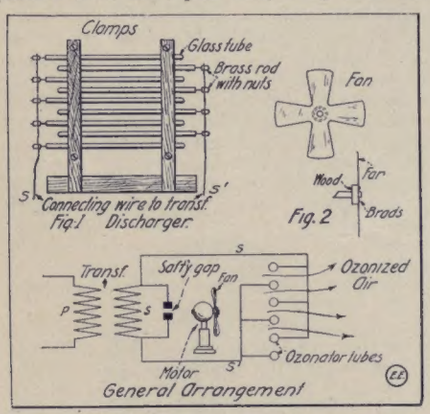
BUILDING AN OZONATOR.

Much has appeared in various magazines about electrical ozonators. An ozonator is an apparatus for producing ozone. Ozone is a colorless gas having the odor of moist phosphorus. It can be produced by means of electrical discharges.

The construction of a very efficient ozonator is detailed here. It consists of three parts; first, the discharger; second, the coil or transformer for producing the electric tension; third, the fan for forcing the air across the gaps where the electrical tension exists.

The discharger is made similar to a condenser. The articles necessary are nine glass tubes, each having a bore or inside diameter of 3/16 inches and a length of about seven inches. Each tube is sealed at one end by means of an alcohol lamp. One end is left open. Nine brass rods, eight inches long by 5/32 inches in diameter, each threaded for ¾ inches at one end only and each rod is equipped with two nuts for connections. Also two clamps for holding the glass tubes a specified distance apart, viz., 1/16 inches. The tubes are thrust over the rods or vice versa.

Rods: The metal rods may be fastened on the tubes by means of some paraffine or wax. The first tube is placed with the open end, i. e., with the



nuts on, toward the right. The next one toward the left, and so on. All rods and tubes are clamped evenly between the clamps as in Fig. 1. (In some case it may be necessary to leave every other glass tube out in order to produce a sufficient amount of ozone.)

The motor is equipped with a fan and placed directly behind the discharger so as to force ozone out into the room. The fan may be made of sheet brass or any rigid metal. It is five inches in diameter and has four blades. It can be conveniently fastened to the shaft of a motor by a small piece of wood or a tube (A Fig. 2).

The discharger is connected as in Fig. 1, the leads going to the transformer as assembly shows.

A safety gap should be placed in the circuit if a transformer is used; connecting it across the secondary terminals of same.

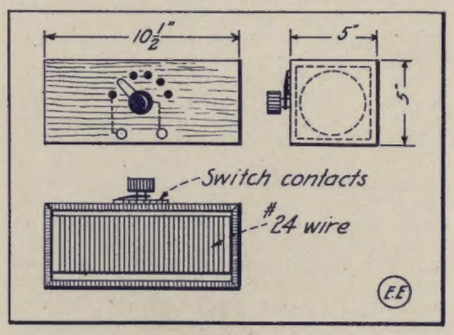
This discharger may be connected to your wireless coil already in use, but it is preferable to make it portable. Do not use a transformer over 250 watts; 110 watts is the best and any voltage transformer may be used, i. e., over 5,000 volts. This set works admirably on 110 watt, 13,000 volt transformer and fills a spacious room with ozone in a very short time. If a spark coil is used, one giving a two or three inch spark, is preferred. All material mentioned here may be purchased of the E. I. Co. The motor may be such as Nos. 100, 179 or 1880.

Contributed by J. NORDSTROM.

A SIMPLY MADE LOADING COIL.

Here is a description of a neat and efficient loading coil.

The woodwork is made of one-quarter inch hard wood and you need two pieces 5" square; two pieces 10"x5" and two pieces 10"x4¼". In Fig. 1, the blade is a No. 5,000 E. I. Co. Rheostat blade costing 10 cents, with a half dozen E. I. Co. switch points and the terminals are hard rubber binding posts. In Fig. we see a cardboard tube 5"x11" which may be procured from the "Electro" people for



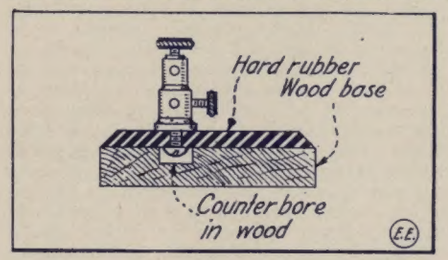
25 cents and taps are brought out at every two inches along the winding and are fastened to the switch contacts as shown. The tube is wound with No. 24 B. & S. single cotton, or enameled magnet wire. The drawings serve to make everything quite clear. This coil in connection with any ordinary receiving transformer will tune to about 3,500 meters.

Contributed by
STUART SANDREUTER.

IMITATION RUBBER BASES.

All high class Radio instruments have hard rubber bases. Amateurs often desire hard rubber instrument bases, but are held back by their high cost. A good substitute is described below, which is made comparatively cheap.

A hard rubber base of desired size is obtained and which should be but ⅛ inch thick. The parts are mounted on this base and then a hard wood base the



same size as the rubber base but about ¼ inch thick, is procured and holes drilled in it in such a manner that none of the metal parts touch the wood.

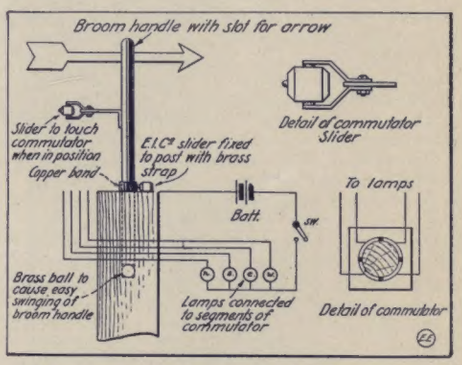
The next step is to paint the wood base with a black shellac which contains aniline dye, but no carbon. If aniline dye is not available you can use thin black asphalt paint. Of course the edges of the wood and rubber should be well matched before painting.

Contributed by W. R. COTTRELL.

ELECTRICAL WEATHER VANE.

Below you will find drawings as near accurate and as clear as I can draw them of an out-door weather vane, which registers in your own room. The broom stick, in which is set the arrow, may be of most any length and should be set in a six inch square wood block, not less than seven or eight inches high, which should have its lower end resting on a brass ball to let the rod turn very easily. On the rod is screwed an arm with an E. I. Co. slider secured at the end of it, as in the drawing, to make contact with the commutator. This rod is connected with a copper ring at the base as shown with a wire. The commutator should be constructed as follows:

A wooden block seven inches square and an inch thick with a hole six inches in diameter cut from the center. The best way to do this would be on a lathe as the whole secret lays in the perfect shape of this hole. Around the inside of this hole should be tacked four equal lengths of very thin copper. These should be tacked on with a small space between them, about an eighth of an inch, and they should not touch as it will cause a short-circuit. This com-


Broom handle with slot for arrow
Slider to touch commutator when in position
Copper band
E.I.Co slider fixed to post with brass strap
Detail of commutator Slider
To lamps
Batt.
SW
Brass ball to cause easy swinging of broom handle
Lamps connected to segments of commutator
Detail of commutator

Schematic arrangement of electric Weather Vane indicator

mutator is held in place by strips fastened to the post to hold it firm. From each section of the commutator, insulated wires are lead to lights with letters or names on them as in drawing. Now when the wind blows it will swing the arrow, causing the broom stick to turn, thus connecting the slider with the respective segment of the commutator and consequently lighting the light, which is connected with its respective segment. A switch may be put in the circuit as in drawing, thus enabling the wind direction to be read at will.

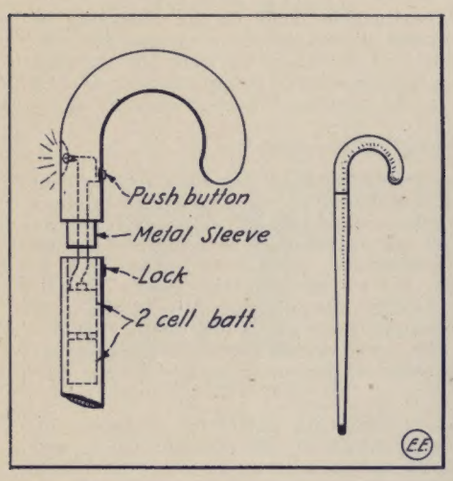
Contributed by
RANDOLPH ROLAND.

DISSIPATING FOG BY WIRELESS.

The North Railroad company in France is making experiments on the use of wireless waves for clearing away fog. It is well known that electric waves make up fog, so as to dissolve them and turn them into vapor. Following this idea, it is claimed that as much as 600 feet can be cleared up in front of the electric wires which are sending out the waves, the fog being at least partially dissipated, and this will have a great value in practice, especially for railroads and ships.

ELECTRIC LIGHT ON CANE.

Imported canes and walking sticks are often fitted with electric flash-lights for the convenience of the owner, and these are usually quite expensive of course. An electric flash-light cane is easily improvised by any one, as shown in the illustration, and all that is needed is a small 2½ volt flash-light bulb, such as the E. I. Co., supply, (No. 5,008 at 25c.);



a 2 cell battery No. 10,420 at 25c.; a miniature receptacle No. 1,052, some flexible silk-covered cord, and a small push button, as No. 4,285, or this may be made from a piece of brass and a screw for a contact. The lamp battery and push button are wired in series in the usual manner. The cane, which should be a fairly thick wooden one, is to be cut in two near the handle, and a 7/16" drill run down into the base section, to form a chamber for the battery of two cells, (placed end to end). The handle may be joined to the base by a piece of threaded brass tube forced or threaded into the wood of same, and also into the cane base section. The flash-light battery here used comprises two cells, each about 7/16" by 2" long. The brass shell from the socket is removed from the porcelain or an "Electro" *miniature to candelabra* adapter shell No. 10,005 may be utilized. The ingenuity of the reader will serve to arrange the cane in a neat and strong manner.

ELECTRICITY FROM DUST.

The curious experimental electrical machine described by W. A. Douglas Rudge to the Cambridge Philosophical Society depends on dust.

When clouds of dust are raised—either by the wind or by artificial means—they are always strongly charged with electricity, which is positive or negative according to the nature of the material; and it is possible to obtain a continuous supply of electricity by using suitable apparatus to drive a dust-laden stream of air thru an insulated tube.

While the dust is passing the tube will yield a steady stream of sparks, sometimes more than two inches long. The air escaping also carries a charge which in a room may be retained half an hour or more.

The charge is probably due both to the actual raising of the cloud and to friction of the dust against the tube. Such dust may be used as flour, sulphur, road dust or fine iron filings.

ELDON GARDNER, RADIO ENTHUSIAST.

Eldon Gardner, son of R. D. Gardner of Adams, Mass., has just completed a wireless aerial 40 feet in height and 70 feet in length. It is suspended from the chimney on the house to the flag pole on the barn. He has a complete sending and receiving set which he constructed himself and with the new aerial he expects to receive messages from 300 to 500 miles and send messages about two miles.

A rising Marconi receiving wireless signals "a la bedstead" according to the "Wireless World"

BOOK REVIEW.

"Experiments" by Philip E. Edelman, Published by the author. 1914. 250 pages, Profusely illustrated. Cloth. Price $1.50 Net. Postage 8 cents.

Mr. Edelman has given us an interesting treatise on Experiments in chemistry, electricity and mechanics, for those who are interested in these subjects. There are 34 chapters in all, arranged in 2 parts. The elements of applied experimental science are given in an interesting way with suitable illustrations. High frequency and wireless currents are covered with data on spark coil construction up to 10 inch coils; Experimental aeronautics; microscopic photography; Electricity in Horticulture; Blow-pipe work; Novel Experiments with glass, and many other inviting subjects.

QUEEN CITY RADIO ASS'N.

Following the disbandment of the L. W. O. of W. N. Y., the faithful members who still held together organized a much better association. This newly organized association is to be known as the "QUEEN CITY RADIO ASS'N." The club has a good start and we mean to take advantage of it. We hope to live up to the motto we have chosen.

The aim of the club is to advance the newly invented science among the amateurs in BUFFALO and vicinity and also produce good fellowship among the fellows. The officers are R. E. Corts, Pres., Harold Capen, Vice-Pres., Roland Houck, Treas., Harold Stoeckel, Chief-operator, Lawrence H. Wolff, Secretary. The secretary will be glad to take care of any correspondence addressed to him at 63 Goembel Ave., Buffalo, N. Y.

IMPROVEMENTS IN LECLANCHE BATTERIES.

A note in a recent issue of the "Engineer" gives details of a French patent relating to a primary battery of the Leclanche type, in which in the positive electrode of dioxide of manganese and graphite the graphite is replaced by lamp-black obtained from the decomposition of acetylene. When acted upon by an electric spark discharge, gaseous acetylene decomposes to hydrogen and carbon, thus giving a chemically pure carbon. Its density is only 0·9, while that of graphite is 2·17 to 2·30. In this way it is possible to increase the proportion of dioxide of manganese and obtain a more regular working of the cell than with natural graphite whose composition is variable. The finely divided state of the acetylene carbon is also claimed to give a more intimate mixture with the dioxide, and hence a better result. Another patent relates to a method of working batteries of the above type so as to use considerable current from them and at the same time not to run the battery down. The inventor treats the usual dioxide and graphite mixture by adding to it an oxide of mercury, preferably red mercuric oxide, and in such case the output of the cell may be increased several times and the battery can thus give heavier currents than before, while still maintaining the voltage. He further strengthens the battery by using an alkaline electrolyte, such as caustic soda or potash.

(*The Electrician, London.*)

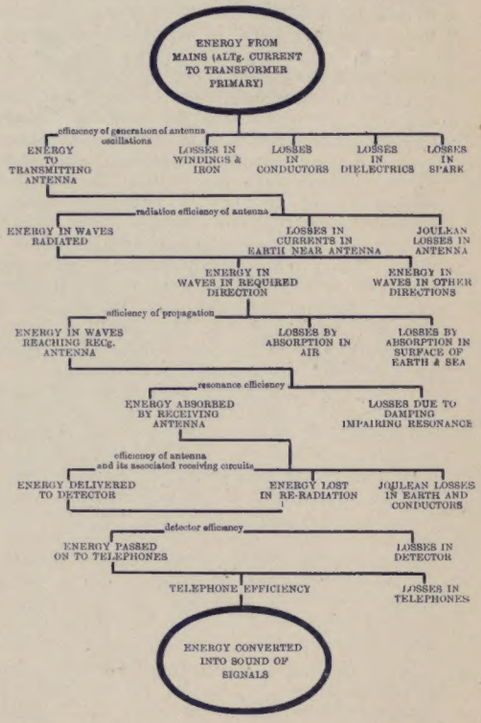

ENERGY FROM MAINS (ALTg. CURRENT TO TRANSFORMER PRIMARY)
efficiency of generation of antenna oscillations
ENERGY TO TRANSMITTING ANTENNA
LOSSES IN WINDINGS & IRON
LOSSES IN CONDUCTORS
LOSSES IN DIELECTRICS
LOSSES IN SPARK
radiation efficiency of antenna
ENERGY IN WAVES RADIATED
LOSSES IN CURRENTS IN EARTH NEAR ANTENNA
JOULEAN LOSSES IN ANTENNA
ENERGY IN WAVES IN REQUIRED DIRECTION
ENERGY IN WAVES IN OTHER DIRECTIONS
efficiency of propagation
ENERGY IN WAVES REACHING RECg. ANTENNA
LOSSES BY ABSORPTION IN AIR
LOSSES BY ABSORPTION IN SURFACE OF EARTH & SEA
resonance efficiency
ENERGY ABSORBED BY RECEIVING ANTENNA
LOSSES DUE TO DAMPING IMPAIRING RESONANCE
efficiency of antenna and its associated receiving circuits
ENERGY DELIVERED TO DETECTOR
ENERGY LOST IN RE-RADIATION
JOULEAN LOSSES IN EARTH AND CONDUCTORS
detector efficiency
ENERGY PASSED ON TO TELEPHONES
LOSSES IN DETECTOR
TELEPHONE EFFICIENCY
LOSSES IN TELEPHONES
ENERGY CONVERTED INTO SOUND OF SIGNALS

Chart showing the successive losses occurring in a radio system.
(From Dr. W. H. Eccle's article in *"Wireless World"*)

Following nine years' experiments with wireless and wire telephony, Dr. F. H. Millener, experimental engineer of the Union Pacific, states that he has developed his apparatus so that it is now commercially practical in all respects, and that a complete system of communication is ready to be installed on Union Pacific and overland trains.

WIRELESS DEPARTMENT

Crystal Detectors and Electrothermal Action

By Dr. W. H. Eccles*

IN a paper to the Physical Society Dr. Eccles deals from a new theoretical standpoint with "Electrothermal phenomena at the contact of two conductors," and develops a theory of the action of crystal detectors.

In his introductory paragraphs he says:

"When an electric current is caused to pass across the interface between a pair of conducting masses, heat is in general liberated or absorbed in accordance with the law of Peltier. When the masses are in contact over a very small area, as, for example, when a cylinder of graphite is laid across a copper wire, there may be, in addition, appreciable generation of heat in accordance with the law of Joule. If the substances constituting the contact are bad conductors of electricity and of heat, and if they stand far apart in the thermoelectric series, the phenomena arising when a current is forced across the joint become very striking, for in such circumstances relatively large amounts of heat may be developed, the heat is conserved, and therefore the thermoelectric effects enhanced.

"It is evident that the thermoelectric forces called up by the local heating may assist or may oppose the E.M.F. applied to produce the current and that the phenomena of a symmetric conduction at once arises. But besides the Joule and Peltier effects, the Thomson effect may contribute to the phenomena. In the case of bad conductors of heat the temperature gradients very near the contact will be very steep, and thus the Thomson effect will be localized in the immediate neighborhood of the contact.

"Further than this it is obvious that, on account of the temperature changes, the portions of the substances near the contact will suffer a change in the magnitude of their electrical resistivity. It has been shown* that this effect alone leads to remarkable and important results and is sufficient to account for all the principal features of the single-point coherer used in wireless telegraphy.

"The thermoelectric forces and the changes of electrical resistance that arise from differences of temperature are much greater in combinations of such substances as iron pyrites than in combinations of ordinary metals. A pyrites-lead couple yields an E.M.F. some 200 per cent. greater than a bismuth-lead junction, between the same extremes of (ordinary) temperatures; while the temperature coefficient of resistance of pyrites is probably four times as great numerically as that of copper. But the thermal conductivity of pyrites is so very much smaller than that of lead that all these thermoelectric phenomena are greatly accentuated in the former case. Contacts between non-metallic conductors are of special interest, for the reason that the bulk of the wireless telegraphy of the world is carried on by aid of detectors that consist of nothing else than a contact involving at least one non-metallic conductor.

"The thermoelectric constants of such substances as pyrite, zincite, carborundum, etc., are not easy to measure accurately, and their coefficients of increase of resistance with temperature are exceedingly difficult to determine. The author has made numerous determinations, and has found that all the materials examined follow with fair precision the ordinary thermoelectric law that their thermoelectric powers are linear functions of the temperature, and also that their temperature-resistance coefficients are all large and negative."

The writer goes on to consider a circuit including a loose contact, such as that formed by a piece of pyrites pressing against a piece of metal; the other junction making a very good contact, so that its temperature remains unchanged.

"Let an E.M.F. be applied to the circuit in any manner so as to produce a current in the direction opposite to the E.M.F. that would be produced by heating the contact. The heat liberated near the contact is, per absolute unit of electricity flowing through the contact, equal to the thermoelectric force e plus the heat absorbed at the co'd junction.

"This heat tends to be concentrated in a small volume of the substance near the contact, but is dispersed continually by thermal conductivity and radiation. We will assume that the rate of loss of heat by these agencies is, as a whole, proportional to the excess of temperature of the junction over its surroundings. The rise of temperature causes an alteration of the electrical resistance of the joint; let the true resistance at any temperature above the temperature of the surroundings be expressed by p (1+fO) where f is a temperature coefficient dependent on both the substances at the contact."

*"Proc." Physical Society of London. Vol. XXII., p. 869.

His mathematical investigation leads to the obtaining of an equation for the current y sent across a typical detector-junction, in terms of the P.D. (voltage) between the extreme ends of the conductors which vary in temperature. If this P.D. be represented by x, the equation obtained, omitting negligible terms, is

$$ax^2y^2+cxy^2+bxy-x+py=o.$$

The constants a, c, b in this equation are mainly dependent on the Thomson effect, the change of resistance with temperature, and the Peltier effect respectively. If the part of the circuit which undergoes no appreciable temperature-change possesses the constant resistance r, and the applied E.M.F. be denoted by e, then $x=e-ry$, and the steady current *characteristic curve* as usually drawn from observations of applied E.M.F., and consequent current is identically that obtained by applying to the curve drawn from the above equation of a homogeneous shear of amount r parallel to the axis of x.

The author proceeds to deal with particular cases in this equation assigning various values to the constants a, c, and b, and showing the derived curves.

The paper itself should be consulted by all who are interested in the subject; it is too long for a full abstract to be given here. Among other interesting conclusions arrived at, it is indicated that when the constant a is positive, the current produced by a definite voltage is greater when the voltage is negative than when it is positive; while when a is negative or zero the positive voltage produces the greater current. Now, various writers (if we remember rightly, Professor Pierce in particular) discredit the theory that crystal-rectification is due to thermoelectric action, on the ground that when some such contacts are warmed by direct communication of heat the thermoelectric force is in the opposite direction to the current produced by the rectifying action. Dr. Eccles considers that this argument is a fallacy; for the observation of the direction of the thermoelectric force produced by direct heating shows only the sign of the Peltier effect and not the sign of the Thomson effect in the circuit, and thus ignores the sign of the important constant a.

There is, we think, another argument against the thermoelectric explanation of crystal-action—the fact, obtained experimentally, that the maximum current produced thermoelectrically may be thousands of times less than the rectified current produced from an alternating current which gives rise to the same increase of temperature at the contact.

We do not know whether the experiment referred to was carried out in such a way that the two cases could truly be compared, but we should doubt it, since the current produced by rectification would depend on what point of the curve was being worked on.

We have submitted the above point to Dr. Eccles, and he takes the same view, pointing out that his mathematical treatment shows that if the E.M.F. e is adjusted to a sharp bend in the curve, the rectified current might be enormous compared with the thermoelectric current. Thus things which show no thermoelectric E.M.F. may be good rectifiers, and he quotes as an example a pair of pieces of galena, which form a very good rectifier at a certain E.M.F. (about ½ volt), but which show no thermoelectric action.—*Wireless World.*

E. A. Strong of Winnipeg, Man., Canada, writes The E. I. Co. the following:

"I received the type 'S S' dynamo No. 1,331 in good order. I am well pleased with it and I must thank you for the prompt attention you gave my order and the prompt shipment also.

"As a motor, I think it is a wonder; such power for so small a machine. I am using it as a generator driven by an induction 110 volt A. C. motor and it sure is a perfect little generator."

HOW-TO-MAKE-IT DEPARTMENT

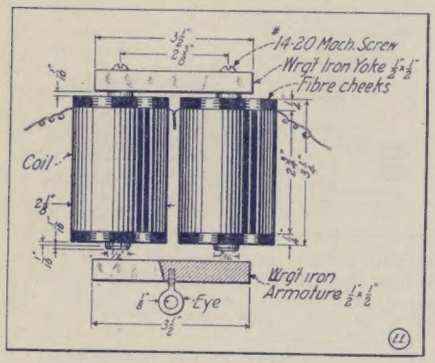
This Department will award the following monthly prizes: FIRST PRIZE $5.00; SECOND PRIZE $2.00; THIRD PRIZE $1.00. The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical, and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted, a prize of $5.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE, $5.00.

A USEFUL ELECTROMAGNET.

By Henry G. Morrison.

An electromagnet is described below which can be used for a variety of purposes, such as lifting, demonstrations,



window displays, etc. The iron parts consist of commercial wrought iron stock, procurable from any iron dealer or blacksmith. It should be soft annealed stock. The drawing shows the dimensions of the magnet frame and winding spools. These are made of ¼" fibre, hard rubber or wood discs of circular form, with holes drilled in the rear discs to bring out the leads from the coils, which leads had best be made flexible so that the inside lead cannot be broken off easily, which creates no end of trouble.

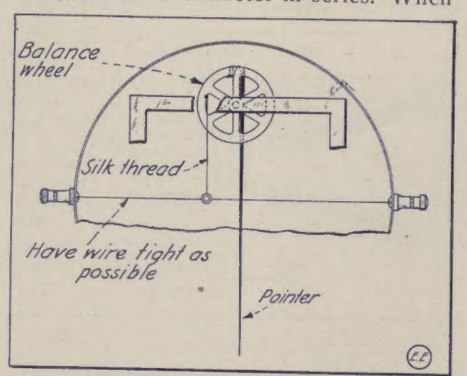
The coil bobbins should be wound full of magnet wire and about 3lb 5 oz. of No. 30 enameled copper wire is used on the both spools; (total wire) for 110 to 115 volts D. C. service. For battery circuit the coils are composed of the same amount of wire, but No. 20 S. C. C. or enameled wire is used. This considers about 12 volts battery potential and 1.15 amperes. If 6 volt battery current is to be used on it then the two coils can be connected on parallel, when the current will be twice the above of course, or 2.30 amperes. On 110 volts the magnet is extremely efficient and takes but one tenth (0.1) ampere. Its maximum tractive or lifting effort is about 28 lbs. as tested by the writer with the 115 volt D. C. winding. The resistance of the two coils in series (No. 30 wire windings) for 115 volt D. C. service is 1,100 ohms. For the 12 volt winding the resistance is about 10 ohms. The heavier wire had best be wound in even layers for highest efficiency. The magnet cores between the fibre and discs should be covered with three layers of oiled linen or empire cloth. Paper can be used for this work. Shellacking the coil gives a good tough outer coating, but for the fine wire winding the coils ought to be covered with paper or bookbinder's cloth to protect the wire from damage. Enameled magnet wires gives the maximum efficiency as more turns can be put in a given space than with any other insulation. The pole faces are tapered slightly where they make contact with the armature, to increase the flux density at these points.

SECOND PRIZE, $2.00.

MAKING A HOT-WIRE AMMETER.

A Hot-Wire Ammeter is usually a luxury beyond the purse of the average radio amateur and the simple style here described will undoubtedly be of interest to your readers. It is made up of an old alarm or other clock movement, as perceived, and all the wheels are removed except the balance wheel and hair-spring. To the top of the balance wheel is secured a pointer which deflects over a scale, calibrated to read in amperes, and fractions thereof.

To one side of the balance wheel is fastened a piece of silk thread which ends in a glass bead thru which passes the heating element wire, which is drawn between the two binding posts on the case of the meter. The parts should be so adjusted in relation to one another, that when no current passes thru the instrument, the pointer is at zero on the scale. The heavier the wire, the greater the capacity of the instrument, but to be accurate on high frequency or wireless currents, the wire to be heated by the current must be kept small. If the heating strand is to carry the whole current and no shunts are to be employed, as is the best practise for this class of measuring instrument, then the heating element may be composed of several strands of No. 36 B. & S. copper wire connected in multiple and those are preferably arranged or mounted side by side and parallel with a slight space between the strands, to allow of equal heating and cooling of each strand. The proper number of strands for a certain capacity in amperes is found easily by experiment and the calibration is carried out on direct current, connecting this hot-wire meter and a regular D. C. ammeter in series. When



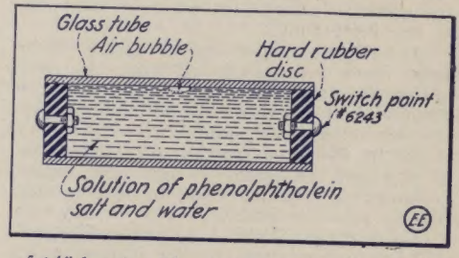
1 ampere shows on the scale of the D. C. meter then the point reached by the needle of the new meter on its scale should be marked. In this way the whole scale of the meter is calibrated, and a rheostat, together with a few battery cells, etc., serve to give the necessary current values for the purpose. One of the small "Electro" ammeters is excellent for this work, as they are quite accurate indeed. Also a 16 C.P. carbon filament lamp on 110 VTS. D. C. passes about ½ ampere; A 32 C.P. 110 VT. lamp passes about 1 ampere; Two 32 C.P. lamps or four 16 C.P. lamps on parallel take about 2 amperes on 110 VTS., etc. Of course the two binding posts and the whole heating element of the meter are to be well insulated by mica or other washers placed around the base screws of the binding posts. This principle here described will serve for making a hot-wire radio type ammeter for any capacity and also the multiple stranded heating element ensures accuracy in the high frequency readings.

Contributed by H. CAINE.

THIRD PRIZE, $1.00.

AN ELECTRO-CHEMICAL POLARITY INDICATOR.

The following is a description of a simple and efficient polarity indicator which the writer has constructed and is using with excellent results. The materials needed are a glass tube, piece of hard rubber and 2 switch points. Procure some phenolphtalein and dissolve one tablet in 1 oz. water. Next add as much salt as the solution will dissolve. Cut a piece of glass tubing about three inches in length and turn two pieces



of ⅜" hard rubber to fit tightly into tube. In the exact centre of each piece drill a hole exact size of shank of switch points and mount same on each side.

Fill tube with the solution and close up ends by inserting rubber discs; leaving a small air bubble in the tube.

Now any current passing through the tube will turn the solution near one electrode **red.** This is the **negative** pole. If the tube is tilted so that the air bubble comes in contact with the red part of the solution, the red part will disappear and the tube is ready for another test.

Contributed by J. L. GREEN.

RENEWING DRY CELLS.

A worth while and inexpensive way of renewing old flashlight batteries is to put a small amount of vinegar in the top, in which can be made a small hole to admit the vinegar. If let stand a while the battery will be nearly as good as new.

This may also be successfully applied to old dry cells that have been discarded from automobiles, etc.

If this method is to be used on dry cells it will be a good plan to drill two or three holes about $\frac{1}{16}$ of an inch in diameter and as far down as possible being careful not to pierce the bottom. Plug up the holes after recharging.

Contributed by

LEO J. PRINDIVILLE.

Wrinkles—Receipts—Formulas—Hints

By S. Gernsback.

Under this heading we will publish every month useful information in Mechanics, Electricity and Chemistry. This department will be edited monthly by Mr. S. Gernsback. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 3.

Lacquerings for Metals.

Always apply lacquer with a good brush when the metal is warm, otherwise it will not spread evenly.

Black Lacquer—1 lb. *Asphaltum,* ¼ lb. *Lamp-black,* ½ *lb. Rosin,* 1 qt. *Spirits of Turpentine.* Dissolve the asphaltum and rosin in the turpentine; then rub up the lamp-black with linseed-oil, only sufficient to form a paste, and mix with the others. Apply with a brush.

(1) *Japan Lacquer*—All Colors.—1 lb. *Gum Sandarach,* 2 ozs. *Balsam of Fir,* 2 ozs. *Balsam of Tolu,* 2 ozs. *Acetate of lead,* ½ pt. *Linseed Oil,* 2 qts. *Spirits of Turpentine.* Put all into a suitable kettle, except the turpentine, over a slow fire, at first, then raise to a higher heat until all are melted; now take from the fire, and when a little cool, stir in the spirits of turpentine and strain through a fine cloth. This is transparent; but by the following modifications any or all the various colors are made from it.

(2) *Black.*—½ oz. *Prussian Blue,* 2 ozs. *Asphaltum,* ½ pt. *Spirits of Turpentine.* Melt the asphaltum in the turpentine; rub up the blue with a little of it, mix well and strain; then add the whole to one pint of the first, above.

(3) *Blue.*—Indigo and Prussian blue, both finely pulverized, of each ½ oz.; spirits of turpentine 1 pt. Mix well and strain. Add of this to one pint of the first until the color suits.

(4) *Red.*—Take spirits of turpentine ½ pt.; add cochineal ½ oz. Let stand 15 hours and strain. Add of this to the first to suit the fancy.

(5) *Yellow.*—Take 1 oz. of pulverized root of curcuma and stir of it into 1 pt. of the first, until the color pleases you, let stand a few hours and strain.

(6) *Green.*—Mix equal parts of the blue and yellow together, then mix with the first until it suits the fancy.

(7) *Orange.*—Mix a little of the red with more of the yellow and then with the first as heretofore, until pleased.

(8) *Pink.*—Mix a little of the blue to more in quantity of the red, and then with the first until suited.

In this simple and philosophical way you get all the various colors. Apply with a brush.

Gold Lacquer for Tin.—Transparent, all colors.—½ pt. *Alcohol in a flask,* add 1 oz. *Gum Shellac,* ½ oz. *Turmeric,* ¼ oz. *Red Sanders.* Set the flask in a warm place, shake frequently for 12 hours or more, then strain off the liquor, rinse the bottle and return it, corking tightly for use.

When this varnish is used, it must be applied to the work freely and flowing, or, if the work admits of it, it may be dipped into the varnish, and laid on the top of the stove to dry, which it will do very quickly; and they must not be rubbed or brushed while drying; or the article may be hot when applied. One or more coats may be laid on, as the color is required more or less light or deep. This is applied to lanterns, etc. If any of it should become thick from evaporation, at any time, thin it with alcohol. And by the following modifications, all the various colors are obtained.

(2) *Rose Color.*—Proceed as above, substituting ¼ oz. of finely ground, best lake, in place of the turmeric.

(3) *Blue.*—The blue is made by substituting pulverized Prussian blue ½ oz. in place of the turmeric.

(4) *Purple.*—Add a little of the blue to the first.

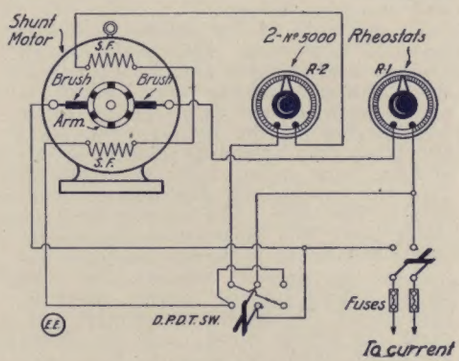
(5) *Green.*—Add a little of the rose-color to the first.

Here again philosophy gives a variety of shades with only a slight change of materials or combinations.

Lacquer for Brass (Transparent).—1 oz. Turmeric root, ground fine, ½ dr. best dragon's blood put into alcohol 1 pt. Place in a moderate heat, shake well for several days. It must be strained through a linen cloth and put back into the bottle, and add powdered gum shellac 3 ozs.; then keep as before in a warm place for several days frequently shaken; then again strained, bottled and corked tight.

CONTROLLING SPEED OF A MOTOR.

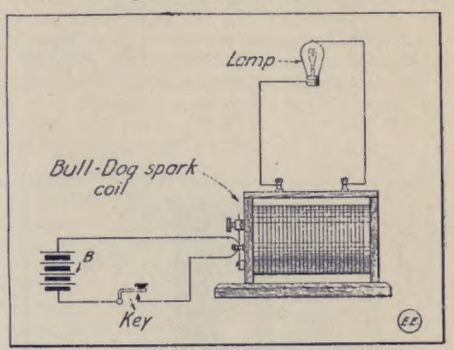
Many times it is desirable to control the speed of a battery motor such as the "Electro" type "S S" 1/30 H. P. operating on 6 volts, from dry or storage batteries. This motor is shunt wound, i. e., its field winding is connected on parallel to the armature terminals. The connection of two No. 5000 Rheostats for controlling the motor speed above or below normal, is indicated plainly in our sketch reproduced here. One rheostat is inserted in series



with the armature circuit as at R1; while the other rheostat at R 2, is in series with the field winding. This enables the motor speed to be readily raised or lowered in accordance with the rule that weakening the field of a motor will raise its armature speed, and vice versa; also that speeds below normal are obtainable by a variable resistance in series with the armature. It is well to place a fused switch in all motor service mains; or a couple of small E. I. Co., fuse blocks No. 918 may be used on battery service quite effectually.

A SIMPLE GEISSLER TUBE.

An incandescent lamp is connected to one post of a "Bull-Dog" spark coil. The other post is connected to the top

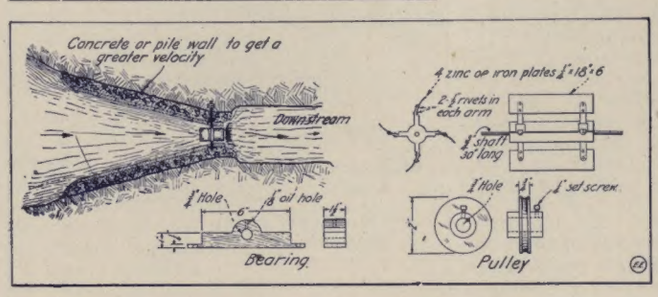


of the globe, but does not have to be. When the current is turned on, a bluish glow will result which resembles the glow of a geissler tube.

Contributed by
GEORGE F. STIMMEL.

A WATER WHEEL FOR DRIVING DYNAMOS.

I recently spent a week in the country and built a small water wheel which developed considerable power suitable for driving a dynamo for electric lighting and thought I would describe same for the benefit of your readers. The drawing explains itself very well, and the brook was converged by a wooden pile wall as shown or concrete may be advantageously employed to increase the velocity of the water thru the water wheel channel. The wheel may be made large or small depending upon the amount of water available and the pressure; also the wheel blades may be of metal or wood, and bucket shaped paddles are of course the most efficient.



The pulley on the water wheel is so proportioned that the dynamo will be driven at the proper speed to develop its correct output. The rule for pulley computations is that the diameter of one pulley, times its speed in revolutions per minute, (R. P. M.) divided by the diameter or speed in R. P. M. of the second or other pulley gives directly the missing quantity for the second pulley; both pulley diameters being figured in inches. Many farms having access to a lake or brook can in this way produce electric lights without any maintenance expense, excepting the initial cost of the plant; including dynamo, storage battery, etc., which are fully described and priced in the E. I. Co.'s New Cat. No. 14.

Contributed by EDWARD MENNIE.

(*For a comprehensive article on Hydro-Electric Plants of small size, with data on high pressure turbines of "Electro" make, see the May,* 1914, *"Electrical Experimenter."*)

THE "ELECTRO" MAGNETIC COMPASS AND ITS USES.

The "Electro" magnetic compass, similar to all compasses of this type, consists of a hardened steel needle, magnetized and pivoted at its center, so as to freely move over a calibrated scale, marked off with the usual geographical points, such as N. E. S. W. and intermediate points. This compass is extensively used in

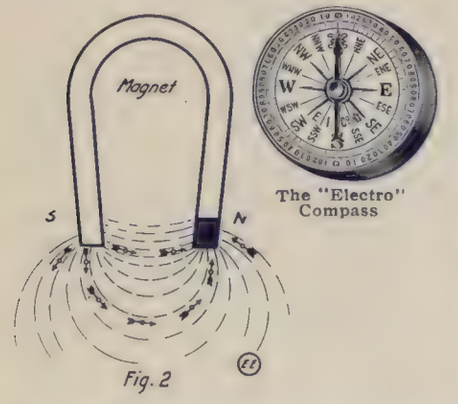


Fig. 2

every day electrical work for various purposes, and can also be used of course for Orientation or the science of finding one's location.

Orientation consists of allowing the compass needle, which is a magnet, to come to rest and in doing so its *North-seeking pole* or arrow-head will always point in the direction of the North Magnetic Pole of the earth. The compass case with its scale, should then be turned until the letter "N" on same is directly under the Arrow-head of the compass needle; and of course it is then easy to determine where E. S. and W. lie with respect to the operator's location, which may be in the deep woods or in any part of the country. This is the method used for steering the large ocean ships, and also by explorers for laying out their journey, etc. See Fig. 1.

Testing magnetic polarity by means of this compass is the commonest accurate way in which to test the polarity of a permanent or electro-magnet; in accordance with the well known rule of magnetism; "like poles repel each other, while unlike poles attract one another." Accordingly, if the North (really the North-seeking pole of the needle, and actually its South pole, in accordance

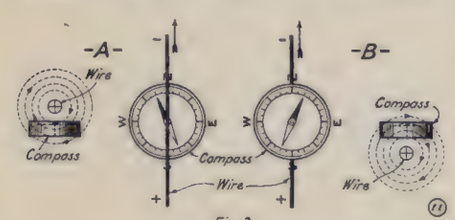


Fig. 3

with the foregoing statement) pole of the compass needle is attracted by a magnet pole, then the latter's polarity is NORTH; and inversely, if the South-seeking pole, of the needle is attracted by a magnet pole, then the latters' polarity is SOUTH. This is the usual method of testing the polarity of the field poles in motors and dynamos by electricians. In the sketches here shown the arrow-head on the compass needle is considered the *North-seeking pole* of the needle, or in reality its *South magnetic pole;* and likewise its tail is the *South-seeking pole,* or its actual *North magnetic pole.* The various positions assumed by such a compass needle in the field of a steel horseshoe magnet is shown at Fig. 2.

Testing Live Wires by means of small compass such as this one is readily accomplished by placing the compass either above or under the wires carrying an electric current as at Fig. 3; the needle will then be deflected either to the right or to the left, depending upon the position of the compass with respect to the wire, and also depending upon the direction of the current thru the wires as indicated in the diagram. A magnetic whirl of field of force is present about every electric conductor, and this is what causes the magnetic compass needle to deviate as shown. A piece of bell wire held over or under the compass will cause it to be actuated even tho but ½ ampere passes thru same, as from an electric bell.

Making a voltmeter with this instrument can be effected by winding a number of turns of the insulated magnet wire, about No. 28 or 30 B. & S. gauge, about the center of the compass case, as indicated at Fig. 4, so that the turns pass over the top and under the bottom of the magnetic needle, and parallel to its axis. In using the instrument so arranged, the compass needle should be allowed to come to rest naturally; or it may be brought to a point of rest artificially by

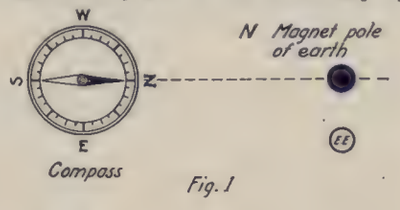


Fig. 1

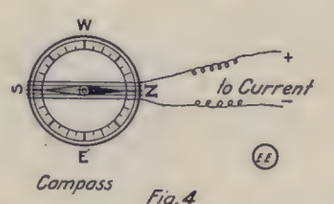


Fig. 4

a small magnet placed near it. The coil of wire and compass case should be turned until it is directly in line with the needle. Now when an electric current is passed thru the coil, the needle will deflect, and if quite a number of turns are used in the coil the instrument will prove very sensitive indeed, and thus forms a simple and efficient galvanometer, suitable for the testing of electric circuits, spark coils windings, telephone receivers, etc. By comparing the instrument so arranged, with a standard voltmeter, various deflections of the needle, with different currents passing thru the coil may be thus checked up; so that after once making such a comparison with a regular voltmeter, such as those supplied by the E. I. Co., etc., future measurements can easily be made with same. It can also be calibrated with ordinary dry cells, as these give quite closely, when new 1.5 volts per cell. Thus the deflection for 2 dry cells (large or small) is 3 volts, etc. Fractions of volt deflections may be judged quite readily in this way.

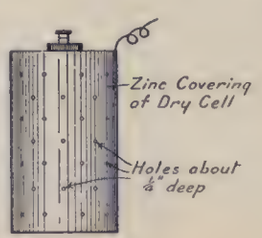
A successful demonstration of wireless telegraphy at 100 words a minute was recently given in England by the Marconi Company between Chelmsford and Letterfrack (Galway).

HOW TO RECHARGE DRY CELLS.

First remove the cardboard wrapper, then with a piece of emery cloth clean the zinc covering. Next with a drill pierce holes round the cell and all the way down making the holes about 1 in. apart. The perforated cell is then put in a 2-lb. glass jar with water and 3 ozs. of sal-ammoniac. This makes an efficient "Leclanche" cell, and will give from 1 to 1.5 volts according to quality of dry cell. If zinc covering is badly eaten previous to perforating wrap a piece of muslin round it; and make the zinc connection from an ordinary cylindrical zinc, as used in Leclanche cells.

The above cell will give voltage mentioned until zinc casing is completely eaten away.

Another method is as follows: Pro-



cure a machine drill of about ⅛" to 3/16" in diameter and drill holes carefully till the drill touches the carbon. Do not be afraid to drill through the entire portion of the depolarizer, as it is necessary that it gets air and electrolyte. It is obvious that drilled holes do not throw up a rim, but leave a flat, clean hole, making short circuit entirely out of the question. We would recommend to drill about 8 or 10 such holes, being careful to see that all manganese (black filler) is carried out of the hole. Blowing hard in the hole will usually clear it perfectly. We also recommend to drill each hole as rapidly as possible, because the drill itself, being in contact with both zinc and depolarizer during the act of drilling, for the time short circuits the cell.

Next prepare a solution of 10 parts (by weight) water and 5 parts of chloride of zinc, which can be bought for about 50 to 60 cents per pound. Ten cents worth will do for about a dozen dry cells. If the solution is kept in a well stoppered bottle it can be used over and over, as each cell does not absorb much liquid.

The solution must be well heated before used, but should not boil. Insert the cell in this liquid and leave in same for about 20 to 30 minutes. The cells should then be taken out and rolled on the floor. Each hole should now be inspected to verify if it is clean and if no filler touches the zinc.

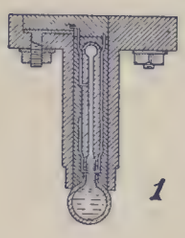
Now dry the cell carefully, and if possible insert in each drill hole a dry wooden plug, which can be cut off flush with the zinc.

The battery is now ready for use and in most cases will register from 8 to 12 amperes and about 1.3 volts.

A. B. Tyrrell, of Medford, Mass., writes the E. I. Co.:

"The instruments I purchased from you some time ago are working perfectly. I am more than pleased with them and would advise any amateur or professional looking for good instruments to purchase the E. I. Co.'s as they do the work. Will favor you with an order in the near future."

LATEST PATENTS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THERMOSTATIC CIRCUIT-CLOSER (Fig. 1)—Really a thermometer with two electrical leads mounted in the walls of the tube, so that undue heat causes the mercury to rise and short-circuit the sealed-in leads, ringing a bell, etc.

BATTERY LAMP MOUNT (Fig. 2)—Readily attached to any dry cell; lamp arranged on a metallic cap slipping over the paper carton of battery.

TELEPHONE TRANSMITTER (Fig. 3)—Improved transmitter having its diaphragm resiliently mounted to minimize distortion of the voice.

AUTOMOBILE SIGNAL (Fig. 4)—Electric lamps illuminate signal or stop signs; a colored light being thrown on movable signal arm when it is raised. When the arm falls colored light goes out and signal sign lamp lights.

DRY CELL (Fig. 5)—A dry cell (so-called) containing a liquid electrolyte with the negative electrode suspended in same. The outer metal shell forms the positive electrode, and the whole is hermetically sealed.

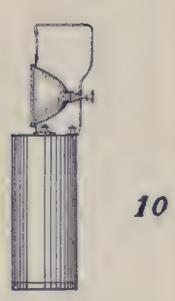
SANITARY MOUTHPIECE (Fig. 6)—A telephone mouthpiece designed to have a liquid disinfectant held in an absorbent between the perforated walls of same.

ANOTHER ANTISEPTIC MOUTHPIECE (Fig. 7)—The powdered antiseptic is held in an absorbent annular chamber, with perforated walls, and the whole device is made attachable to any telephone mouthpiece.

ELECTRIC SHEARS (Fig. 8)—A simple electric shear using a hand controlled switch and a suction or solenoid magnet to actuate the blades.

ELECTRIC DISINFECTANT DISTRIBUTER (Fig. 9)—Disinfectant holder arranged to be mounted in front of a desk fan, and fumes from same to be thus blown outward with the air draught.

FLASH-LIGHT (Fig. 10)—A removable lamp, switch and handle arranged to fit on any common dry battery, and made of ½-inch metal strip.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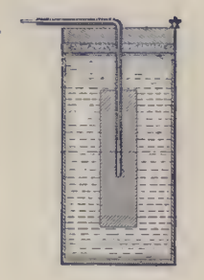
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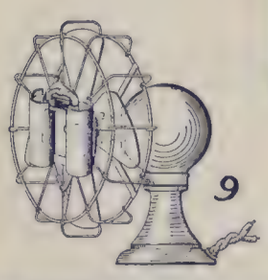
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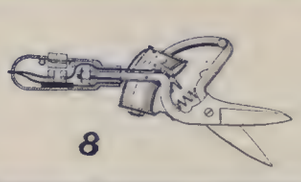
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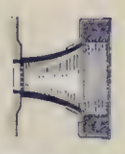
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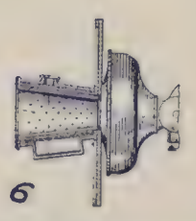
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ELECTROLYTIC INTERRUPTERS AND HOW TO USE THEM.

By H. Winfield Secor.

Electrolytic interrupters are widely used for operating X-ray spark coils and wireless coils, etc., but do not always give the best of satisfaction, and just why this is so is explained briefly below.

It has been found in practice, and several authorities, including Dr. J. A. Fleming, in his excellent work, "The Principles of Electric Wave Telegraphy," state that the self-inductance (not resistance), of the circuit connected in series with these interrupters is not always sufficient to properly operate same, and if *no inductance* is included in the circuit the interrupter *will not work at all.* This is quite an important matter, and is frequently lost sight of by the user of such apparatus. Besides increasing the working qualities of the interrupter, an adjustable reactance (such as a choke coil), connected in series with the circuit containing the interrupter permits of limiting the current passing in such a circuit, and this is essential to prevent flickering of the lights on house-lighting circuits, which trouble is oftentimes very pronounced.

The electrolytic interrupter when connected in series with the primary winding of a good ½ kw. transformer coil (of the open core type; closed core transformers cannot be operated by it), should draw from 5 to 6 amperes. The circuit voltage may be from 50 to 110 volts, A. C. or D. C. The A. C. frequency should not be lower than 50 cycles, and better 60 cycles. The solution for the interrupter is composed of 5 parts pure water and 1 part of pure sulphuric acid. In mixing these ingredients, the acid should always be poured into the water, and not vice-versa, as otherwise the solution is liable to be forcibly ejected from the containing vessel. The frequency of the interrupter varies with the amount of inductance and voltage of the circuit, and sometimes reaches a value as high as 7,000 interruptions per second, as compared to two or three hundred per second, obtained from ordinary spring vibrators.

In cases where the interrupter fails to work satisfactorily, or passes too much current, a choke coil is generally the solution of the problem. Such a coil is easily made for ordinary purposes, by using a soft iron wire core 8 inches long by 1 inch in diameter, the weight being about 1.33 pounds. This core should be insulated with three layers of Empire cloth or shellacked paper. Over the insulated core is wound 3 layers of No. 14 B. & S. gauge enameled or D. C. C. copper magnet wire (about 2 pounds is required); leading taps off from each layer so that the self-inductance in circuit may be varied by connecting to one or more layers as required. It is best to arrange the iron core to be moved in and out of the coil, which gives a very wide range of reactance adjustment. When the electrolytic interrupter is employed the spark coil vibrator should be cut out by screwing up the contact screw tight; or short circuiting the vibrator with a piece of copper wire.

Another easily remedied trouble with electrolytic interrupters is that of heating, the solution often becoming very hot especially where X-ray coils are operated steadily for long periods. The remedy for this trouble is to form a cooling worm out of thin lead pipe, having an inside diameter of ¼ to ⅜ inch, and the worm may have 4 to 6 convolutions. This pipe worm should just fit nicely into the interrupter jar, so as not to interfere with the working parts. Cold water is circulated through the worm by attaching one end of it to an ordinary spigot by means of a piece of rubber tubing, and the other end of the worm is connected with a piece of rubber tubing to a sink.

An easier way, but not as effective, is to place the interrupter jar within a larger vessel, and circulating cold water through same. This outer vessel is probably best composed of metal, as it is then an easy matter to provide a waste outlet by soldering a small piece of brass pipe into the side of the vessel, near the bottom. The water is fed into the top of the container, and thus a steady circulation of cool water is maintained about the interrupter jar.—*Reprinted from January, 1913, issue of Modern Electrics.*

AMONG THE AMATEURS

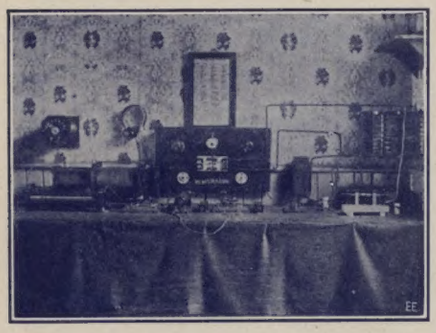
AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

WIRELESS LABORATORY OF W. MORRISH.

I am so glad to see you are starting to publish photos of wireless stations in *The Electrical Experimenter*. I am enclosing a photo of my wireless station. My receiving set consists of tuning transformer, double slide tuning coil and a loading coil, with galena detectors, variable and fixed condensers and 1,000 ohm Murdock phones. The aerial has four wires, 60 feet long, suspended on two poles; one 40 feet high and the other 32 feet. My ground is of iron buried in the earth. I am quite satisfied with my receiving set. I can hear W. S. L.; N. A. A.; Cape Cod, and many nearby stations. My sending set consists of an automobile ignition coil, condensers, spark gap, helix, batteries and key. I can transmit about two miles. I have an amateur's Government license, but at present we are all suspending operations on account of the war.

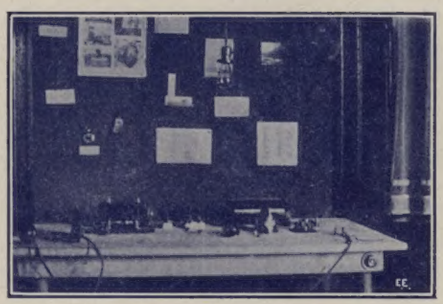


Yours truly,
W. MORRISH,
Gravenhurst, Ontario, Can.

GEORGE RIEGER'S RADIO OUTFIT.

Here is one view of my wireless station.

A one inch spark coil is seen on the left hand side of the picture. In front of this is the spark gap, which I made, and in back of the spark coil is a glass plate condenser. In the center is the aerial switch and on the right hand side, a little to the front of the picture, is a Mesco key. Back of this is the tuning coil with two sliders and in front of this a variable condenser.



The detector is to the right of the variable condenser which is of silicon type and a fixed condenser is used also. I also have a buzzer test.

A pair of 75 ohms receivers are laying on the left hand corner of the table. *The Electrical Experimenter* is enjoyed by my brother and myself every month. I don't see how you can publish it so cheap.

GEORGE RIEGER, Jr.,
Penllyn, Pa.

WIRELESS ON DELIVERY VANS

Motor delivery vans of one of London's largest tobacco firms have been equipped with wireless apparatus in order that help may be rushed to needy smokers on the receipt of the signal S. O. S., meaning, "Send on Smokes."

This firm claims to be the only one in the world using the wireless in its delivery system. The firm communicates thru a station on the roof of the building. Aerials are placed on the vans, manipulated by an operator inside.

W. R. Hughes, of Vonore, Tenn., writes the E. I. Co., N. Y.:

"I have bought several dollars worth of wireless goods from you. I have your 3000 ohm receivers, and I hear Sayville, N. Y., 'N. A. A.,' and several other stations, mostly every night, and some days, with a galena detector."

U. S. WIRELESS TRUCK HAS 800-MILE RANGE.

Remarkable advance in the construction of portable wireless sets for army field service has been made by the Signal Corps of the United States Army. For the next field operations of the army there is available a wireless truck which can be set up for use in twelve minutes and send messages within a radius of 800 miles under favorable conditions.

The truck was built especially for the Signal Corps by the White Company, of Cleveland. In tests that have already been made this set has received messages from points 2,500 miles distant. The electrical pressure reaches 90,000 volts at the top of the antennae. The great range of the new equipment and the speed with which it may be brought into action is due to the employment of a powerful electric generator driven thru a train of gears by the thirty-horsepower motor of the White truck.

The generator delivers electric current of 500 cycles at 110 volts and from eighteen to thirty-two amperes. This current is interrupted by the relay, operated by the sending key, and is transformed so that it leaves the sides of the wireless truck at a pressure of 22,000 volts and an amperage varying from eight to twelve. As the current rises to the top of the antennae the voltage rises to approximately 90,000 while the amperage approaches zero.

The radiation under these conditions gives a sending ability from 200 miles under the worst conditions in day time up to 800 miles under good conditions obtained in the early hours of the morning when there is less electrical disturbance due to electrical plants of various kinds.

The antennae is of the umbrella type, mounted at the top of an eighty-five-foot mast which is built in nine sections. The first, or top, section is raised by hand but the other sections are lifted by a block and tackle suspended from struts mounted on a platform on the roof of the truck.

Anent The "Radioson Detector."

Harry Bostrom, of Indianapolis, Ind., writes the E. I. Co., under recent date:

"I received the 'Radioson Detector' cartridge you sent me, and it is alright. Have tried it out and find it works well."

C. er of Melbourne, Victoria, Australia, writes us: "The 'Electro' set I bought from them in 1910, is still doing good service and it has played its part in getting them consterable business from several parties in Melbourne.

32,000 H. P. TURBINE.

The Westinghouse Machine Company of Pittsburgh, Pa., has received an order from the Edison Electric Illuminating Company of Brooklyn Borough, New York, for the largest steam turbine engine of the single unit type that ever has been ed.

This engine will be rated at 32,000 horse power and will be eneration of electric current to furnish electrical power.

INSTALL WIRELESS AT CAMP GROUND.

And important side of modern warfare is emphasized at the brigade camp at the Joe Hooker campgrounds, Mass., by the practical work of Capt. Harry G. ha e wireless station was erected by the corps at the farther end of the field, and baseball scores, horse racing results and general business notes and bulletins of news were received by this means. In fact, the operator was in touch with Wellfleet station, Siasconset and Charlestown, and from the station near the Middleboro railroad station orders were given and sent to headquarters at camp.

MELTING POINTS OF METALS.

The melting points of some metals which fuse at very high temperatures are published by G. K. Burgess and R. G. Waltenberg in the "Journal of the Washington Academy of Science." The melting points are as follows: Titanium, 1795° C. (3,263° F.); vanadium, 1,720° C. (3,128° F.); chromium, 1,520° C. (2,768° F.); manganese, 1,260° C. (2,300° F.); iron, 1,530° C. (2,786° F.); cobalt, 1,478° C. (2,692° F.); nickel, 1,452° C. (2,545° F.)

Donald Harris, of Deep River, Conn., has installed a very complete and up-to-date wireless outfit in the rear of his home which is affording him plenty of amusement during his summer vacation. Harold French is also experimenting in wireless telegraphy.

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. **At least one of the questions must deal with "E. I. Co." apparatus or instruments, or "E. I. Co." merchandise.**
2. **Only three questions can be submitted to be answered.**
3. **Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.**
4. **Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this Department cannot be answered by mail.**

BATTERY SOLUTION.

(178.) Norman Henning asks:

Q. 1. Where can I find a price list of E. I. Co. chemicals, and also how much Bichronate of Potash should be used to a pint of dilute sulphuric acid in batteries to prevent polarization, and to increase the voltage to 2 volts?

A. 1. In reply to this query, would refer you to the January, 1914, *Electrical Experimenter,* and prices of chemicals are listed therein which the E. I. Co. supply and no orders for less than $1.00 worth of chemicals are accepted.

In regard to your battery solution inquiry, would say that the usual mixture for this solution is as follows:

5 parts water, 1 part sulphuric acid and 2 parts Bichromate of Potash, by volume.

SMALL DYNAMO TROUBLES.

(179.) Chas. C. Haddock, Burkehaven, Lake Sunapee, N. H., complains of trouble in operating an "Electro" No. 810, 8 volt, 10 ampere, D. C. shunt wound generator, etc.

A. 1. We would suggest that the armature in the No. 810 dynamo may be driven in either direction usually, and if it does not generate promptly upon driving same in say one direction, it may be reversed, or also the shunt field connections may be reversed so that the machine can build up properly from its residual field magnetism.

In case the machine should fail to generate at once after trying the above, a few cells of battery may be connected in series with the shunt field winding for a few minutes, to magnetize the field magnet. The positive and negative pole may be ascertained by means of pole test paper; or also by placing two wires connected to the terminals of the machine into a glass of salt water, and the wire giving off the most bubbles is the negative wire.

INDUCTION COIL CURRENTS.

(180.) James L. Green, Rosser, Manitoba, Canada, writes us about the action of induction coils, etc. We advise him as follows:

A. 1. Replying to your communication in reference to a statement regarding the action of induction coils as made in Dr. J. A. Fleming's book, "Principles of Electric Wave Telegraphy," would say that this statement is correct, and all induction coils frequently produce alternating current, but of course it practically never approaches anything like a true sine wave form.

We refer you to the July, 1914, *Electrical Experimenter,* which covers this subject in detail, and also some oscillographic curves are there given, as reproduced from a small spark coil and also from a medical coil. The ordinary small medical induction coil, which does not have any condenser across the vibrator, produces a fairly strong inverse or vibrator MAKE current; but, however, the vibrator BREAK current is always the more pronounced, and very markedly so in the case of spark coils of course, due to the action of the condenser across the vibrator, etc., and the spark discharge from induction coils is always of a predominating polarity; and this may be tested in several ways as explained in the article aforementioned; and for small medical coils a low voltage polarity indicator such as the liquid or chemical paper test can be used to ascertain the polarity of the secondary current.

It is very difficult for us to judge what branch of Electrical Engineering you would prefer to follow and this is always a matter of individual or personal judgment. It is also very difficult to answer your third question, as to which is best to utilize for general experimenting, i. e., a 1 K. W. closed core step-up A. C. Transformer or a 10" spark coil, but the Editor in general would prefer the 10" spark coil.

RADIO INSTALLATIONS.

(181.) P. G. S., Jr., Boston, asks:

Q. 1. Please give instructions for setting up and operating types S. O. 200 and R. O. 2,000 E. I. Co. Wireless Telegraph sets.

A. 1. We are pleased to advise you as follows:

Aerials.

The aerial for this set should be of the horizontal or inclined type and have an average elevation above the ground of 100 to 125 feet. The aerial wires are spaced 3 to 4 feet apart, and are best composed of No. 14 Antenium wire or stranded cable, with insulators placed at the end of each strand. The lead-in wires are spliced onto the aerial strands at one end, and a few feet below the aerial they are joined into one heavy wire forming the lead-in wire; and this is led to the blade of the lightning grounding switch, so that when the blade is thrown to the grounded jaw, the aerial is effectually grounded; which should always be done when the station is not in operation or during electric storms. The length of the aerial may be 100 to 150 feet. All joints on the aerial for best results should be soldered with a non-corrosive flux such as resin or "Solderall." Great care should be exercised to see that the aerial wires and the lead-in terminals are carefully insulated, so that the high voltage sending currents from the transformer does not leak away, instead of sending out wireless waves.

Transmitting Instruments.

The connection of the various transmitting instruments will be readily perceived by looking at the blue-prints furnished with them, and the primary source of energy may be 110-220 volts A. C. or D. C. and about 15 ampere fuses and knife switch, should be placed in the primary feed wires. Ground connections for the kick-back preventer should be made to a separate ground terminal. Considering the high voltage sending circuit, which is supplied with a voltage of about 50,000 from the 2½ K. W. transformer coils No. 8050, it is seen that the plate glass condenser is connected across the transformer coil secondary terminals. The adjustable spark gap of the set in series with the primary winding of the oscillation transformer is connected across the plate glass condenser previously mentioned; and the wave length of the closed oscillating circuit is varied by moving the contact on the primary coil. The secondary winding of the oscillation transformer connects to the aerial and ground thru the aerial switch; connecting the hot wire ammeter in series with the aerial lead. In operating the transmitter the spark gap in the closed oscillating circuit is always quite short and a heavy loud blue-white spark should occur in same, the length of the gap being about ⅛ to 3/16 of an inch in most cases. The transmitting set is tuned by adjusting the contacts on the primary and secondary of the oscillation transformer coils; until the loudest spark occurs in the spark gap and the hot wire ammeter registers a maximum deflection, which denotes that the set is in tune, and that it is radiating maximum power. The No. 8100 aerial switch is thrown forward for transmitting and backward for receiving.

The Receiving Set.

The receiving set employs a loose coupler or receiving transformer and the slider terminals of the primary or outer winding are connected to the rear terminals of the aerial switch as shown in the blue prints furnished. The two secondary or inner coil terminals are connected to the variable condenser No. 3500 and also to the rest of the receiving set as indicated. The small Jr. Fixed condenser No. 10010 should be connected with a switch in series with it as shown, so that it may be disconnected from across the telephone receivers, as it is only in rare cases that it is necessary. The tuning of the receiving set is accomplished by adjusting the position of the sliders on the primary coil, and also by moving the secondary coil in and out of the primary coil; as well as by alternating the secondary circuit inductance. At the same time the capacity of the variable condenser No. 3500 is adjusted and this in some cases is used connected across the terminals of the primary winding. The incoming telegraph code signals are heard in the telephone receivers as short and long buzzes, and can be deciphered by any telegraph operator knowing the code used, and the standard Morse radio code is the one in general use.

PLENTY OF ELECTRICITY.

In the concluding part of a recent address before the wireless society of London, A. A. Campbell Swinton, speaking of the wireless transmission of power, first referred to the strong belief of Messrs. Tesla and Penderson in its future, and then called attention to the fact that on a clear day the earth receives from the sun no less than 4,500,000 horse power to each square mile of surface. This enormous supply of power comes in the form of electro-magnetic waves and via wireless. Evidently, therefore, there is no doubt as to the possibility of transmitting stupendous amounts of energy without wires. Regarding the possibility of using this carrier efficiently for any other purpose than that of simple communication, Swinton seemed skeptical.

ELECTRICITY AND LIFE.

The human body is an electrical machine. It, together with all the intelligence it has ever had, or ever will have, came from the sun. Permeating the universe, being in fact the universe itself, is one supreme principle. This principle may be called God, or the soul, or the supreme power, or anything else that you wish to call it; but within it, and it alone, lies everything that the human mind can conceive of and countless other things as well. It is the power, wisdom, and beauty; the all in all, the Existence itself—there is nothing else beside. There are not two or more, there is but one. Everything that exists is but a manifestation of it. This principle, for the want of a better definition and to get it within the range of the human mind, will be called sun-power, because the sun appears as its first seat in the natural universe. In the sun it separates itself into TWO and appears as electricity.

The TWO appear as ONE, being electricity, having two opposite qualities, positive and negative. The positive and the negative bear within themselves the law of attraction and repulsion, without which no form can live. The positive current of electricity is acid, the negative is alkaline, and these two principles stand at the head of chemistry exercising authority over action and reaction, thus directly giving rise to the phenomena of matter and their countless changes.

The method whereby worlds are built is that a magnetic or electric center sets up and connects with the sun. The instant this connection is formed, a stream of positive electricity flows from the sun to the newly formed magnetic center and this river of electricity carries with it the elements and matter which are deposited at the magnetic center when the current becomes negative and starts on its return to the sun. Chemical action then sets up and as ages go by the magnetic center becomes filled in with minerals and other forms of life until a vast and complicated productivity of living forms has been evolved. How really little solid matter is in existence may be inferred from the fact that the cremation of the human body leaves an insignificant residue, while the burning of a large oak tree, would leave but comparatively little ashes. This disappearance of bulk is but the retreat of matter into its more volatile forms, forms approximating perhaps those utilized by it in its interplanetary movements. The very seas themselves, vast as they are, may readily be rendered invisible to our eye and their beds left bare, thus showing that seas are not necessarily permanent in nature since provision for their movement has been provided. Indeed, the seas, as well as the rest of the earth, flows from the sun upon an electric current and if they ever depart from this globe they will leave it in the same way and they will go to the sun or to whatever other electric center the earth may be connected with. The sun is the master distributor of electricity in the solar system and electricity is the only form of transportation and communication between the sun and the planets. The sun draws in the electrical energy from space and from exchanges with planets and sends it out in definite, direct streams to planetary bodies. A planet is a magnetic center, negative to the sun. Its density is the result of being filled in with matter from chemical action and reaction, arising itself from the acid and alkaline poles of the positive and negative current which connects it with the sun, its distance from the sun depends upon its density, the more solid planets being near the sun. A gaseous planet assumes a point remote from the sun toward which it moves as it is filled in by chemical action and assumes density, because the density is brought about by mineral deposits and other chemical creations which make the planet more attractive to the sun.

The sun is not, therefore, a ball of fire, as has been supposed, but it is the center of electrical energy and it may be a very inhabitable place.* The influence that the sun exercises upon living forms would indicate that our vital origin is resident in sun power and that we arrived on this planet in a stream of electricity that constantly flows from the sun to the earth. If this theory is true, and it has much more to recommend it than most of the superstitious vagaries that occupy the human mind, then it is true that our real nature is one of High Power and that our ultimate destiny is one which our quondam gods might well envy. For then, with the intelligence that research will give, will come the power of inter-planetary travel and all that it implies. And with this, too, comes the knowledge of chemistry in life processes that will enable us to detach ourselves from a material body on one planet make the trip and instantly assume another body suitable to existing conditions upon another globe, instead of, as perhaps at present, being obliged to await the slow process that natural law has provided for the period of unconscious evolution.—*"Riches."*

*(Indeed??!! Ed.)

ELECTRICITY ON THE FARM.

It is estimated that there are at least 2,000,000 gasoline and oil engines on the farms in this country at the present day, and this number is being added to at the rate of 500,000 annually. The average size of these engines is about seven horsepower.

A great many farmers who have already installed engines for power purposes would also like to have electric lights for the house and farm buildings and other electrical conveniences, but do not know how to go about it to secure the necessary apparatus.

The necessary auxiliary apparatus consists of a small electric generator, a storage battery and the necessary wiring and lamps. The generator is belted to the gas engine and run until the storage battery is charged; then it is stopped and not started up again until necessary. Generally, two or three short runs during the week will be sufficient, and even less where only a few lamps are used at a time.

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